

**REMARKS**

Review and reconsideration on the merits are requested.

Claim 14 defines a novel and unobvious combination of features which forms a humidity sensor. Included among the features of this humidity sensor is a lower electrode comprising a noble metal porous body, a porous moisture sensitive layer and an upper electrode comprising a noble metal porous body successively formed on an insulating substrate, wherein the upper electrode is joined to the moisture sensitive layer and a portion of the insulating substrate. The size of pores in the upper electrode is 0.5-20  $\mu\text{m}$ , the size of pores in the lower electrode is 0.5-20  $\mu\text{m}$ , the size of pores in the moisture sensitive layer is 0.05-0.2  $\mu\text{m}$ , particles of ceramic are incorporated in an amount of 1-20 weight % into the upper electrode, and particles of ceramic are incorporated in an amount of 1-20 weight % into the lower electrode. Moreover, one or both of the lower electrode and the upper electrode predominantly contains Pt. As claimed in claims 20 and 21, one or both of the lower electrode and the upper electrode predominantly contains Pt and further contains Rh.

As required by independent claim 14, “the upper electrode is joined to the moisture sensitive layer and a portion of the insulating substrate”. In this manner, the present invention provides a humidity sensor exhibiting enhanced durability, and which can maintain excellent humidity detection performance over a long period of time. Particularly, this is the case even when the sensor is exposed to an atmosphere which undergoes a drastic change in temperature and contains a very small amount of oxygen and a considerable amount of a reducing gas, such as the atmosphere in an exhaust pipe of an automobile; or even when the sensor is provided, for example, in a fuel or air feeding line of a fuel cell. See page 3, lines 3-13 of the specification.

Turning to the cited prior art, claim 14 was rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent 4,379,406 to Bennewitz et al in view of U.S. Patent 5,855,849 to Li et al, U.S. Patent 4,602,426 to Kampe et al, U.S. Patent 4,656,455 to Tanino et al, further in view of U.S. Patent 3,377,203 to Mobius et al.

The Examiner cited Bennewitz et al as disclosing a humidity sensor substantially as claimed, except for (i) an arrangement where the lower electrode, moisture sensitive layer and upper electrode are successively formed on the insulating substrate; (ii) a structure in which the upper electrode is joined to the moisture sensitive layer and a portion of the insulating substrate; (iii) a pore size of the upper electrode of 0.5-20  $\mu\text{m}$ ; (iv) a pore size of the lower electrode of 0.5-20  $\mu\text{m}$ ; (v) a pore size of the moisture sensitive layer of 0.05-0.2  $\mu\text{m}$ ; and (vi) particles of ceramic incorporated in an amount of 1-20 wt% into the upper and lower electrodes.

Citing Figs. 6 and 7, the Examiner relied on Li et al as disclosing a humidity sensor in which upper electrode 33 (43) is joined to moisture sensitive layer 31 (41) and a portion of insulating substrate 34 (44).

Kampe et al was cited as disclosing the claimed electrode pore size.

Tanino et al was cited as disclosing the claimed pore size of the moisture sensitive layer.

Mobius et al was cited as disclosing electrodes containing ceramic particles within the scope of claim 14.

The reason for rejection was that it would have been obvious to modify various elements of the humidity sensor of Bennewitz et al in view of the teachings of the secondary references to arrive at the invention of present claim 14.

Applicants traverse, and respectfully request the Examiner to reconsider for the following reasons.

1. **Combination of Li et al and Bennewitz et al:**

Li et al (newly cited) is said to disclose a humidity sensor in which the upper electrode is joined to both the moisture sensitive layer and a portion of the insulating substrate.

As motivation for making the suggested combination, the Examiner considered that

**“Therefore, it would have been obvious to modify Bennewitz to include this teaching since by adding this feature, it would provide a good linearity between resistance and relative humidity and improved durability for long-term use at high-humidity environments.”**

However, none of this is taught by the prior art which is a basic requirement of a *prima facie* case of obviousness. See MPEP §2143.01 - suggestion or motivation to modify the references: *the prior art itself must suggest the desirability of the claimed invention.*

Although Figs. 6 and 7 of Li et al may show an upper electrode joined to both the moisture sensitive layer and insulating substrate, Li et al does not describe this structure as a feature of their invention. Nowhere does Li et al mention, teach or let alone suggest that such feature would provide good linearity and improved durability. In fact, other than what is shown in Figs. 6 and 7, Li et al is entirely silent with respect to this feature. Rather, Li et al is concerned with the composition of the moisture sensitive layer.

As pointed out in the remarks portion of the Amendment filed April 20, 2004, in the humidity sensor of Bennewitz et al, upper electrode 28 is formed on moisture sensitive layer 24 and substrate 12 via chrome bonding layer 26. Bennewitz et al does not disclose a structure in which the upper electrode is joined to both the moisture sensitive layer and the substrate, and therefore cannot and does not teach that the subject feature provides good linearity and improved durability.

From a different aspect, it is respectfully submitted that one of ordinary skill would not look to Li et al because of the basic difference in the method of forming the electrode. In Bennewitz et al, the electrodes are formed by deposition. On the other hand, in Li et al, the electrodes are formed by screen-printing. It is respectfully submitted that Li et al does not teach or suggest to one of ordinary skill to (i) eliminate the bonding layer of Bennewitz et al formed by deposition and to (ii) replace with the structure of Li et al. More particularly, Bennewitz et al specifies that upper electrode 28 is formed on moisture sensitive layer 24 and substrate 12 via chrome bonding layer 26 for good reason, and such bonding layer cannot be omitted without also destroying the intended function of Bennewitz et al.

As discussed in the Remarks portion of the Amendment filed April 20, 2004, none of the other references cited by the Examiner discloses this feature of the invention as well.

Therefore, the Examiner has failed to establish a *prima facie* case of obviousness, because the suggestion or motivation to modify the moisture sensor of Bennewitz et al does not come from the prior art. Rather, the Examiner improperly borrowed from the teachings in Applicants' specification in setting forth motivation for combining the cited references.

For example, with respect to various features of the invention including a structure where the upper electrode is joined to the moisture sensitive layer and a portion of the insulating substrate, Applicants specification at page 3, lines 6-8 teaches:

**“A humidity sensor having this configuration exhibits enhanced durability, and can maintain excellent humidity detection performance over a long period of time.”**

Furthermore, as a result of implementing such structure, Applicants' specification at page 9, lines 10-13 teaches:

**“The first embodiment of the invention provides a humidity sensor of high accuracy exhibiting excellent durability, in which the strength of adhesion between an insulating substrate and a moisture sensitive layer is enhanced.”**

However, there is nothing in Li et al. (or even in Applicants' specification) relating to “linearity” in reference to a structure where the upper electrode is joined to the moisture sensitive layer and a portion of the insulating substrate, or otherwise.

**2. Combination of Kampe et al and Bennewitz et al:**

Kampe et al relates to improved gas diffusion electrodes for use in primary batteries, fuel cells and electrochemical cells such as those used in alkali metal halide electrolysis processes, but not to humidity sensors. Furthermore, it is respectfully submitted that there is no technical motivation for combining these references in the manner suggested by the Examiner. Namely, because in Bennewitz et al the thickness of the electrode is 7 Å to 1,000 Å (column 6, line 3), there is no room to form pores having a size of 2-50 µm as described in Kampe et al. That is, these references are not properly combinable or modifiable because their intended function

would be destroyed (i.e., no technological motivation) as a result of such combination. For this additional reason, it is respectfully submitted that the Examiner has not established a *prima facie* case of obviousness.

**3. Combination of Mobius et al and Bennewitz et al:**

Mobius et al also relates to fuel cells, and not to humidity sensors. Furthermore, Bennewitz et al discloses an essentially pure  $\text{Al}_2\text{O}_3$  layer 24 (semiconducting  $\text{Al}_2\text{O}_3$  layer, see column 6, lines 64-65), which is quite different from the technique of Mobius et al, in which only a small percentage of aluminum oxide is added to the solid electrolyte (column 3, lines 46-52 in Mobius et al). Thus, for this additional reason, it is respectfully submitted that one of ordinary skill could not readily achieve the invention based on the suggested combination.

**4. Combination of Tanino et al and Bennewitz et al:**

Tanino et al discloses a pore size of 0.1-3  $\mu\text{m}$  in a filter film 10, which is irrelevant and has nothing to do with the humidity-sensing part 4 of the present invention. That is, it is respectfully submitted that there is no reasonable basis to select a pore size for a filter film of the prior art and to then apply that to a humidity-sensing part. They are completely different elements that function in an entirely different manner.

**5. Hindsight Reconstruction of Applicants' Invention:**

The Examiner's rejection relies on a combination of no less than five references, picking and choosing various aspects from each to assertedly arrive at the invention. It is respectfully submitted that one of ordinary skill in the art could not readily arrive at such a specific combination of both structural and compositional elements (i) to (vi) above together with Bennewitz et al. to achieve a humidity sensor of high accuracy and exhibit excellent durability as described at page 19, lines 10-16 of the specification. That is, the rejection (based on a combination of five references for a diverse variety of composition and structural elements) amounts to hindsight reconstruction of Applicants' invention.

For the above reasons, it is respectfully submitted that claim 14 is patentable over the cited prior art, and withdrawal of the foregoing rejection under 35 U.S.C. § 103(a) is respectfully requested.

Claims 15-18 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bennewitz et al in view of Li et al, Kampe et al, Tanino et al, Mobius et al, further in view of U.S. Patent 5,792,938 to Gokhfeld. The Examiner relied on Gokhfeld as disclosing arrangement of a heater and a temperature measurement resistor in the insulating substrate of a humidity sensor.

Claim 19 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Bennewitz et al in view of Li et al, Kampe et al, Tanino et al, and Mobius et al, further in view of U.S. Patent 4,608,232 to Sunano et al. Sunano et al was cited as teaching the measurement of humidity in an atmosphere containing a small amount of oxygen and containing a reducing gas.

RESPONSE UNDER 37 C.F.R. § 1.116  
U.S. Application No.: 09/971,711

Claims 20 and 21 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bennewitz et al, in view Li et al, Kampe et al, Tanino et al, Mobius et al and further in view of U.S. Patent 3,223, 609 to Reeds, Jr.

Applicants rely on the response above with respect to the rejection of claim 14.

Withdrawal of all rejections and allowance of claims 14-21 is earnestly solicited.

In the event that the Examiner believes that it may be helpful to advance the prosecution of its application, the Examiner is invited to contact the undersigned at the local Washington, D.C. telephone number indicated below.

Respectfully submitted,



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